THE FORTH BRIDGE.*

BY B. BAKER.

(*Concluded from page* 353.)

The author's experiments conclusively prove that steel is far superior to iron as a material for struts, though the superiority is not so great as when tension members are in question. Thus the Forth Bridge struts will be from 30 to 40 per cent. stronger in steel than in iron, while the tension members will be about 50 per cent. stronger. It does not follow that the steel strut would not be 50 per cent. better also as regards actual work, which is very different to what takes place in a testing machine. , A steel or an iron rail, tested for transverse strength in a machine, will, as a rule, bend many inches, and fail by distortion of the head under the compressive stress. In actual work hundreds of such rails break, but it is the tensile and not the compressive stress which causes the failure, and there is no distortion of the head as in the testing machine. Similarly, when riveted girders break under traffic, it is not the top flanges with a calculated stress on the average of about one-third of the ultimate resistance that give way, but the bottom members, where the calculated stress is only about one-fourth of the ultimate resistance. In short, the universal experience is that fatigue is far more injurious to iron or steel under tensile than under compressive stress, and it follows that the factor of safety should not be the same in the two cases. This is quite consistent with ordinary practice, for probably the majority of girder bridges in this country have equal-sized top and bottom flanges, which, after allowing for the riveting, would give a factor of about 3 for the compression and about 4 for the tension members respectively.

The peculiarities of steel are tolerably well understood now, and amongst other precautions it is especially desirable to so design the joints in tension that no tearing action shall be set up along a line of rivet holes. Accidents of workmanship necessitate the provision of a good factor of safety in steel joints in tension; but, after watching the testing of many steel tubes under compression, the author cannot conceive any accident of workmanship which could bring about the failure of steel tubes such as those in the Forth Bridge, even if the working stress was raised to two-thirds, instead of about one-fourth of the ultimate resistance. In fine, he believes a steel tube to be the most trustworthy member which could be introduced into a great and unprecedented work.

As regards cost of manufacture, the difference is comparatively small between a circular and a rectangular member. The main tubes will be made up circumferentially of ten bent plates, lap-jointed and double riveted through the flanges of ten rolled beams, which will run longitudinally through the whole length of the tube. Stiffening rings will also be introduced at suitable intervals. The junctions of the tubular struts with the tubular bottom members offered some little difficulty at first in designing, but this being surmounted, the manufacture of the junction lengths becomes, as it were, a piece of ship-builder's work, except that the ship-builder has to deal with far more complex curvatures than will be found in the junction lengths.

Before dismissing the question of steel in compression, the author would wish to mention the results of some experiments made by him on steel which had been previously subjected to end pressure in a tube, so that flexure could not occur. The rods were 1 in. diameter by 30 in. long. With the mildest steel, the resistance to flexure was 14.5 tons per square inch in the uncompressed rods, and 22 tons, or say 50 per cent. more, in the rods which had previously been subjected to an end pressure of 36 tons per square inch. With somewhat harder steel, the corresponding figures were 16 tons in the uncompressed, and from 26 to 29 tons in the previously compressed bars—a gain of from 60 to 80 per cent. The bars, when tested in tension, showed no loss in strength or elongation from the previous compression. As 30-ton steel, after the end pressure had been applied, bore as much load without flexure as 54-ton steel which had not been so treated, it is clear that the adoption of mild steel in railway bridges would be much accelerated if some simple practical method could be devised for bringing about the molecular change effected in the above instances by an end pressure.

Is has been stated that the maximum wind pressure upon the 1,700-ft. span has been assumed to be equivalent to a pressure of 56 lbs. per square foot upon double the superficial area of the girder. It is to be regretted that this assumption necessarily involves many matters of pure conjecture. For example, though a wind pressure of 56 lbs. has undoubtedly been registered by anemometers, exposing a surface of a couple of square feet, it has never been proved to prevail instantaneously over so great a width as the 1,700 ft. span. Again, the relative resistance offered by the windward and leeward girders of a bridge have not been measured, and still less has any experimental approximation been obtained to the resistance of an entire bridge with its floor and cross bracing. Probably much may be done by models, and the author intends to so ascertain, if possible, the probable resistance of the Forth Bridge expressed in square feet of flat surface. Experiments with relation to wind pressure have been commenced at the site of the bridge—a pressure board, 20 ft. long and 15 ft. wide, having been fixed on the top of a tower on the island of Inchgarvie, where the central pier of the bridge will be placed. The apparatus is adapted to test the relative resistances offered by different surfaces, and during the progress of the works it is hoped many now open questions may be settled. The experiments will probably not affect in any way the design of the bridge, because the leading features of the design and the working stresses and wind pressure to be provided for have long since been settled with the Board of Trade. Until the experiments are complete, however, it will be impossible to state with precision what factor of safety will belong to the work, though it is possible to state, without reservation of any kind, that in any event the Forth Bridge, as designed, will be relatively stronger than any other bridge yet constructed. Owing to the large dead weight and the spread of the girders at the piers, a wind pressure, equivalent to 2 cwt. per square foot upon the surface of one girder, would be required to overturn the bridge, assuming it not to be held down by bolts. The holding-down bolts provided, however, about double the resistance to overturning, so 4 cwt. of wind pressure per square foot upon the single surface would be required to upset the bridge; and under this ideal pressure, though the wind bracing would, it is true, be on the point of failing, none of the great tubes or tension members of the main girders would even be permanently deformed.

Changes of temperature as well as gales of wind will affect the stresses upon the steel, but to a comparatively insignificant extent. In designing a certain class of work nothing embarrasses an engineer more than questions arising out of the expansion and contraction of materials. An experienced engineer will know that in certain instances he may entirely ignore the influence of temperature, while in others it is all important. For example, if a provision were not made in the case of point rods, the points would fail to close, and great loss of life might follow the consequent derailment of a train, while, on the other hand, infinite complication would result if a similar provision had to be made in a structure like the Crystal Palace, or in long station roofs, or in girders carrying buildings. Only experience could decide whether it would be safe to carry an ornamental ashlar-faced building on a girder 150 ft. in length without running the risk of inducing cracks in the masonry; but the author, having tried it, can say that the effects of temperature in such a case may be safely ignored. Similarly he had used, without inconvenience, girders 630 ft. in length in the floor of a building, and purlines of equal length in the roof a of station. Each case must, however, be dealt with on its own merits; for in another instance, where a gas works roof had fallen down like a pack of cards, he had traced the cause of the accident unmistakably to the expansion of the iron slate battens, which were exposed to exceptionally high temperatures at times. An engineer is apt to consider he has taken sufficient account of expansion if he adopts the conventional course of placing one end of his girders on rollers or sliding plates, so that the bridge may be free to expand in the direction of its length. The superstructure, it is true, may be twice as wide as it is long, but it must take its chance as regards expansion in the direction of the width. Arched station roofs, such as the St. Pancras roof of 240 ft. span and 700 ft. length, seem to require no provision for expansion in either direction. Again, the Victoria Bridge at Pimlico has longitudinal girders 913 ft. in length, and cross girders 100 ft. in length, with no provision for expansion in either direction. On the other hand, at the Southwark Bridge, grooves had to be cut in the masonry to admit of the free expansion of the cast-iron spandrils, which had been fractured by expansion in several instances, though the arch was only 240 ft. in span, and the spandrils were not continuous across the piers. However much the engineer may desire to eliminate stresses due to expansion, he will find it impossible to do so for the very obvious reason that the temperature is not uniform at any instant, and that even in this climate there may a difference of 50° between the temperature in the sun and in the shade. Take the case of an ordinary lattice girder with trough-shaped top and bottom members and double lattices. One side plate of the trough may be highly heated by the direct rays of the sun, and the other be completely in the cool shade, and one tie bar may similarly differ from its companion bar in temperature. If the girder were free to warp in any direction like a thin plank, little stress would result; but as it is not free to adapt itself to the unequal heating, stresses of considerable severity must occur, since 12° increase of temperature is the equivalent as regards elongation of one ton per square inch stress. On a hot sunnday the Britannia tube was found to warp 3 in. laterally and 2½ in. vertically when free to move; and, clearly, if such tendency be restrained, uniformity of stress is unattainable. The Forth Bridge tubular struts would similarly tend to curve under the action of the sun's rays, but, being braced together, they will not be free to do so, and stress must result. Every structure, in fact, is subject to such stresses, which are one of the things covered by the usual factor of safety. Stone buildings and arches are no exception to the rule; indeed, the author, from instances which have come under his own knowledge, is satisfied that the stresses due to changes of temperature are often relatively far more severe in stone than in iron arches.

Since by no practical means could stresses from expansion and contraction be wholly eliminated from the Forth Bridge, it became a matter for careful consideration what provision for expansion would be requisite or expedient, and what could be dispensed with. There could be no doubt, of course, that longitudinal expansion in the 1,700 ft. span should be provided for by placing one end of the 350 ft. girder on rollers where it was supported by the cantilever. The direct stresses would thus be eliminated, but there remained those due to the unequal heating of the different members, as in every other bridge. These stresses were not included in the estimated maximum tension and compression per square inch given in the previous part of this paper, but were assumed, as usual, to be covered by the factor of safety. A more difficult question arose with reference to the portions of the girders between the piers. Thus the Inchgarvie pier consists of four cylindrical masses of masonry, spaced 270 ft. apart longitudinally and 120 ft. apart transversely, centre to centre. The point to be decided was whether the great girders should be bolted to each mass of masonry, or be fixed at one end only of the above 270 ft., and be placed on rollers at the other end. This would be done, as a matter of course, with an ordinary 270 ft. span girder bridge but the conditions here were very different. In the first place, the pressure was enormous, and a bedplate 35 ft. by 18 ft. was not a convenient one to provide with rollers. The most important point, however, was that sudden and unequally distributed gusts of wind caused stresses, which rendered it extremely desirable to dispense with rollers if possible. On considering the question in detail, it proved to be quite possible to do so. The range of temperature in this climate is not really great on well-protected surfaces, as the practical uniformity of temperature a few inches below the ground testifies. Taking the average of twenty years' observations at Greenwich, the mean shade temperature of the different months ranged from 38.94° in January to 62.54° in July. As the average for the whole twenty years was 49.69°, the range was thus merely 11° below and 13° above the mean temperature. Since 12° corresponds to a ton per square inch stress, iron-work bedded at a mean temperature in a mass of masonry might well be subject to no greater stress from variation of temperature than plus and minus 1 ton per square inch, which is far less than would obtain in a so-styled free-to-expand structure exposed to the rays of the sun.

Last year was characterized by great extremes of temperature. In January the temperature fell to 12.7°, while in July it rose to 97.1°, a range of no less than 84.4° in the shade. The lowest mean daily temperature was 19.4° in January, and the highest 78.6° in July—a range of 59.2°. The maximum daily range was 37°, and monthly range 53°, both in July. In the sun the temperature rose as high as 150°, so the extreme range for the year would be no less than 137°. The average yearly range being less than 24°, a clear explanation is thus afforded of the fact so well proved by experience, that provision for expansion is essential in point rods, signal wires and similarly exposed and light pieces of iron-work, while it may safely be ignored in the case of girders inclosed in buildings or bedded in jack arches.

Having reference to the considerations thus briefly set forth, and to the behavior of existing structures of all classes in this climate, it proved, on investigation, to be quite unnecessary, as far as temperature was concerned, to provide rollers at Inchgarvie pier. The steel tubes between the four cylindrical masses of masonry will be covered, like marine boilers, with a couple of inches of "fossil meal" or some other suitable non-conducting material, and an exterior iron envelope. Inside the tubes will be lined with about 2 ft. in thickness of cement concrete, to serve as an equalizer of temperature, and these precautions being taken, the results of calculations show that the stresses from changes of temperature will be of no moment either to the superstructure or to the masonry.

There still remained the question whether, for other reasons than temperature, rollers might not be necessary at Ichgarvie. Since the 270 ft. long

* From a paper read before the British Association.

tubes would be erected upon scaffolding, there would be no stress upon the metal at first, but as the erection of the cantilevers by overhanging proceeded, there would be the gradually increasing thrust from the bottom member, and it appeared difficult to say whether this thrust would come upon the tubes or upon the piers as abutments, unless rollers were introduced. A compressive stress of 5 tons per square inch would shorten the tube 1½ in., and as the stout masonry piers would tilt very little, this movment could not occur, and the tubes would not take up their share of the work unless some sliding were provided for. After a careful consideration of all the conditions of the problem, including changes of temperature, the author came to the conclusion that a certain amount of initial stress on the tubes between the masonry piers was desirable, and although it might at first appear to be difficult to do this with a tube 12 ft. in diameter by 2 in. in thickness, the difficulty vanished, as usual, upon being grappled with. He proposed simply to make the upper and lower bed-plates, which were intended to slide on each other during the erection of the bridge, with serrated surfaces sloping at an angle of one in six. As the co-efficient of the well-greased and planed steel surfaces would not exceed one-twentieth of the load, the shortening of the tube under the compressive stress due to the erection of the cantilevers would proceed freely, whilst the desired initial stress would be put on partly by the weight of the structure and the tightening of the holding-down bolts taking effect on the one in six incline, and partly by the test load of the bridge. A movement of 1¼ in. would be provided for temporarily, and the two bed-plates would finally be gripped together, and made fast to the piers by forty holding-down bolts of 3 in. diameter. When complete, the stresses on the metal would never exceed the limit of 7½ tons under the joint influence of live load, wind, and temperature, and the pressure upon the masonry piers and foundations would be well within the working limits.

It is unnecessary to refer in detail to the mode or erection, as it is obvious that the work will be commenced at each pier, and be proceeded with by adding successive portions to the ends of the cantilevers until the same are complete. The central girders will also probably be erected on the overhanging system, temporary connections being formed between the ends of the cantilevers and the central girder. The closing lengths or key pieces at the centre of each 1,700 ft. span will be put in on a cloudy day, when there is little variation in temperature, and the details will be so arranged that the key piece can be completed and the temporary connections cut away in a few hours, so as to avoid any temporary inconvenience from expansion and contraction.

No special difficulty will arise with respect to the foundations, though the works will be, of course, on an unusually large scale. The island of Inchgarvie is of trap rock, and the central pier at that spot will consist of four cylindrical masses of concrete and rubble-work, faced with granite, and having a diameter of 45 ft. at the top and 70 ft. at the bottom. The height above high water will be 18 ft., and the depth below the same will vary from 24 ft. to 70 ft. After the sloping face of the rock foundation has been cut into steps, wrought-iron caissons will be floated out, lowered into place, and filled with concrete lowered through the water in hopper-bottomed skips. Queensferry Pier will be founded on boulder clay. Open-topped cylindrical caissons, 70 ft. in diameter, with an external and internal skin, 7 ft. 6 in. apart, will be floated out and lowered into place. The space between the skins will be filled with concrete, to give strength and weight to overcome frictional resistance in sinking. Grab excavators will be carried on a turn-table top to the caissons to remove the earth from the interior, and pneumatic apparatus will be supplied to enable men to clear boulders from the cutting edge of the caissons. From a depth of 6 ft. below water upwards, the masonry will be built in the dry, inside a movable caisson connected by an india-rubber joint with the permanent caisson below it. The piers will be carried down at least 10 ft. into the boulder clay, which will give depths ranging from 68 ft. to 88 ft below high water and 18 ft. less at low water in the respective cylinders. In round numbers the weight of one of the cylindrical piers at Queensferry may be taken at 16,000 tons, and the combined vertical pressure on the top of the pier from the dead weight of superstructure, rolling load, and wind pressure at 8,000 tons; so the load on the clay would average about six tons per square foot over the area of the foundation. This is an insignificant amount on such hard clay as that at the Forth, and the margin is ample, therefore, to allow of the unequal distribution of the pressure due to the action of partial blasts of wind and of a certain amount of expansion in the tubes connecting the piers.

The total length of the great continuous girder is 5,330 ft., or say a mile, and of the viaduct approaches 2,754 ft., or rather over half a mile. There is nothing calling for special remark in the viaduct. The piers will be of rubble masonry, faced with granite, and the superstructure of iron lattice girders with buckled plate floor and trough rail bearers, as in the instance of the main spans. The main girders, spaced 16 ft. apart, will be placed under the railway, and there will be a strong parapet and wind screen to protect the trains.

To engineers little need be said respecting the stiffness of a girder bridge having the proportions adopted in the present case. The central girder has a depth of one-seventh of the span, whilst the cantilevers may be looked upon as halves of a girder having a depth of one-fourth of the span. Exceptional depths like these confer exceptional stiffness, and there is the additional fact that the live load of a passing train will be quite insignificant as compared with the dead load of the structure. The heaviest train traversing the bridge will not deflect the 1,700 ft. girder more than 4 in., which is considerably less than the deflection of the 460 ft. span of Saltash Bridge under its test load, whilst a wind pressure, equivalent to 30 lbs. per square foot over the entire 1,700 ft., would bend the bridge laterally less than 9 in.

About 42,000 tons of steel will be used in the superstructure of the main spans, and 3,000 tons of wrought iron in that of the viaduct approach. The total quantity of masonry in the piers and foundations will be about 125,000 cubic yards, and the estimated cost of the entire work, upon the basis of the prices at which the original suspension bridge was contracted for, is about 1,500,000 . Owing to the varying price of steel, and to the magnitude and novelty of the undertaking, this estimate must be taken as approximate only, as a contract has not yet been concluded for the works.

It will be gathered from the preceding necessarily brief and incomplete description of the proposed Forth Bridge that no novel or untried elements enter into the design. In principle, a continuous girder is as old a type of construction as an arch or a suspension bridge; and probably, in prehistoric times, streams were crossed by the aid of a couple of overhanging branches and an intermediate central portion constituting a structure rude in appearance, but identical in principle with the great bridge. The merit of the design if any, will be found, not in the novelty of the principles underlying it, but in the resolute application of well-tested mechanical laws and experimental results to the somewhat difficult problem offered by the construction of so large a bridge across so exposed an estuary as the Firth of Forth.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

(*Continued from page* 341.)

CCCLXXXV.—BRANTFORD.

Brantford, Ontario, Canada in lat. 43° 20′ N., long. 80° 20′ W., is at the head of navigation on Grand River.

Settled about 1830, it was incorporated as a city in 1876. Water-works were built in 1879 by a private company, after plans of C. H. Wilson, taking the supply from a small creek about a mile from the town. The water is partially filtered through gravel, and is then pumped by a Worthington duplex engine, 100 ft. into a brick tank 15 by 26 ft., and 10 ft. deep. For fire protection, a high-pressure engine, built by Watrous & Co., pumps directly into the mains. Distribution is by 4½ miles of cast-iron pipe, 8 to 4 in. diameter, with 50 fire hydrants and 60 taps. There are 8 meters in use. The city pays the company 8 per cent. per annum on their outlay for water for fire and public uses. Service pipes are reported as of cast iron. The population in 1880 was 10,500. The daily consumption in 1881 was 150,000 gallons.

The capital stock of the company is $50.000. The works have cost $48,000. There is no debt.

The expenses in 1881 were $2,310.11, and the receipts $9,127.35.

T. S. Shenston is the Secretary and Treasurer.

CCCLXXXVI.—AUSTIN, NEV.

Austin, Nevada, in lat. 39° 30′ N., long. 116° 35′ W., is in a cañon of the Toyalee range of mountains, on the western slope.

Settled in 1863, it was incorporated as a city in 1864. Water-works were built by a private company in 1865, taking the supply from tunnels tapping a vein of water in the mountains. The water is collected in a brick reservoir holding 50,000 gallons at 500 ft. above the city, and is distributed through about 1 mile of riveted galvanized iron pipe and gas pipe of from 6-in. to ½-in. diameter, with 8 gates and 250 taps. Wrought-iron pipe is used for services. The city has a separate supply for fire purposes.

The population in 1880 was 2,150. The daily consumption in 1881 was 30,000 gallons.

The works have cost $20,000. No further financial statements are given.

H. H. Allen is Secretary and William Foster the agent of the company at Austin.

CCCLXXXVII.—MIDDLETOWN, N. Y.

Middletown, New York, in lat. 41° 25′ N., long. 74° 18′ W., is on Monhegan Creek, in a hilly region.

Settled about 1755, it was incorporated as a village in 1848.

Water-works were built by the village in 1867, taking the supply from springs and surface drainage from a water-shed of 8 square miles. An earth dam 25 ft. high, across a narrow valley, floods an area of 60 acres, forming a reservoir holding 300,000,000 gallons, 150 ft. above the town.

In 1875 there was a deficiency in the supply, and a pump of 12-in. bore and 20-in. stroke, driven by water-power, was erected by the Holly Manufacturing Company, taking a supply from the Shawangunk Kill (the old Dutch name for a creek), 3½ miles from and about the same level as the reservoir, to which the water is conveyed through a 12-in. wooden pipe made in 15 ft. lengths of white pine staves, 2¾-in. thick, banded with strap-iron and coated on the outside with coal tar. After the pipe was laid it was found that the town had no right to use the creek water, and six years of litigation followed before the new works could be used, resulting in the payment of $1,400 for the right to use surplus water flowing over the dam on the stream when the mills were supplied. The pipe follows the surface, descending at one place 75 ft. below the reservoir and at another rising 25 ft. above it. When tested, after lying unused for six years, only three lengths of it burst.

Distribution is by 6 miles of pipe of from 12 to 4-in. diameter, with 40 fire hydrants. The number of taps is not given. There are 6 meters in use. The first pipes laid were of wrought-iron and cement. Some of this has been replaced by cast-iron, which is alone used in extensions.

The population in 1880 was 9,500. The daily consumption is not known.

The works have cost $170,000. The bonded debt is $160,000, at 6 per cent. interest.

The expenses for the year ending May 1, 1882, were:

For maintenance	$1,506.68
For extensions and land and water damages	5,087.10
For interest	11,371.50

The receipts were $10,637.13.

The works are managed by 5 commissioners.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks: From Wm. Foster, agent, statistics of the water-works of Austin, Nevada. From T. S. Shenston, Secretary and Treasurer, statistics of the water-works of Brantford, Canada.

THE NECESSITY, USE, AND CARE OF WATER-METERS.

The rapid increase in population in this country, from natural causes and by immigration, is giving rise to grave fears that the water supply, particularly in the larger cities, will soon be insufficient to meet the growing demand for that necessary adjunct to life and health. Practical men are seriously considering the question, whether to enlarge the sources of supply or to curtail the enormous waste of water which is constantly taking place in all parts of the land. In some cases the former method will be found absolutely necessary in a few years, to say the least. In the city of New York, for instance, the rapid increase of population has already placed the adequacy of its present water supply in doubt, and the authorities are preparing to increase that supply from other sources. But in the great majority of cases a method of stopping the waste everywhere prevalent will be found the most effectual as well as the most economical plan to provide for the requirement of many years to come. To the question, How to stop that waste? I answer, that its practical solution, in my humble opinion, may be found in the use of the water-meter with its system of registration, similar to that by which gas is measured. The facts that many systems of water-works have recently been put in operation throughout the states; that many more are in process of construction, and that others are being contemplated, serve as constant admonitions to the public of the necessity of an economical use of one of "God's best gifts to man." Under a rate based upon a system of registration the consumer is required to pay for all the water which passes through his meter. The more used the greater the expense. A due regard for domestic economy or for the profits of business would be a further incentive to retrenchment in its use by the patron. In this it would be to him a question of dollars and cents; and the purse-pocket is a tender place to the majority of mankind. The general adoption and use of the water-meters cannot be too strongly urged. Soon it will be found of absolute necessity in all cities where water-works exist. Of great practical benefit, its use will also be found to be a handsome source of income to any corporation by which adopted. Having had several years' experience in the construction of water-meters, and having closely observed the uses to which they are put, permit me to offer a few suggestions as to the care which should be bestowed

upon them after being set and ready for operation. This is an important point, though simple, and a knowledge of it will often save the time and expense of disconnecting, examining in shop, and resetting a meter. When a meter has been set and the water allowed to enter it many people suppose that then the work is complete. But the meter does not operate satisfactorily. Perhaps it is not properly adjusted; perhaps it is owing to certain conditions of the water, which may contain grit—lime—or it may be too high a pressure. Don't hammer the meter, you may perhaps bruise it; and if so, will doubtless displace its inside works. No one would think of striking a clock or sewing machine if cut of order. Yet the same gentle treatment bestowed upon these useful articles, when in need of repair, should be given the water-machine if we would reach the end for which it is employed. A careful examination may reveal the presence of paint or red lead inside, which may have been used in the connections in making the joints tight. Whatever the obstruction have it removed, as in a number of instances such might easily be done, and the meter properly re-connected. Nor should a meter be set for service where it could be injured by freezing in cold weather. Some one of these points has frequently caused water-meters to be condemned and returned to the maker as useless. A large percentage which have came under the observation of the writer for repairs were condemned for some one of the above-mentioned reasons, and were easily and speedily set to rights.

The invention and adoption of a water-meter that will cover all the technical points raised by some writers on the subject, in our opinion, we are not warranted in waiting for, and will probably not soon be brought out; at least not in our day. With the universal adoption and proper care shown to the meters now generally manufactured we have enough to fill unlimited requirements for many years to come.

CHAS. H. PAGE.

WORCESTER, MASS., Oct. 2, 1882.

THE IRON MARKET.

[From the Iron Age.]

NEW YORK, Oct. 11, 1882.

American Pig.—The market rules quiet, its chief business being deliveries on old contracts, which go on without interruption, and are said to be sufficient to absorb, if not the entire production, the product of those brands most in favor here. There is very little Iron offering, and no pressure to sell that we can hear of. The tone of the market is strong and values firm as follows: Foundry No. 1 X, $26@$27; Foundry No. 2 X, $24@$24.50; Gray Forge, $22.

Scotch Pig.—The supply of Scotch Iron in this market is unusually light, and most of the afloat lots are said to be engaged. The demand is fair, and but for the high prices prevailing a larger business would be done. Sales reported during the week aggregate over 500 tons various brands. We quote: Eglinton, $23.50@$24; Carnbroe and Glengarnock, $25.50@$26; Coltness, $28; Gartsherrie, $26, and Langloan, $26.50@$27.

Rails.—Sales are reported by Pennsylvania mills of 13,000 tons of Steel Rails for delivery in 1883 at $45, and 1,000 tons near-by delivery at $46 at mill. We quote $45@$46 for Steel. Iron Rails continue to be neglected and prices nominal.

Old Rails.—The business transpiring in Old Rails is very light, and there is scarcely any inquiry. Holders' views are about $27.50@$28 for Tees, and $30@$31 for Double Heads.

PHILADELPHIA, Oct. 10, 1882.

Plate and Tank Iron.—There has been very little done during the past week, so that quotations are more or less nominal. Tank Iron and Common Plates generally could be had at about 3c., but there is no disposition to buy, except small lots, for which extra rates are obtained. The outlook at the moment is decidedly weak and unpromising, but a few good-sized orders would soon restore confidence. In the meantime, quotations are as follows: Tank Iron, 3c.@3.25c.; Shell Iron, 3.8c.@4c.; Flange, 5c., and Fire-box, 6c.

Structural Iron.—There has been very little demand lately, and, although the leading concerns have a good deal of work on hand, they are gradually catching up, and would be glad to see new business coming in, but, with the exception of an order for about 2,000 tons for bridge work, there is no special inquiry at the moment. There is no particular change in prices, but desirable orders would doubtless be accepted at slight concessions from quoted rates, which are 3c. for Angles, 3.85c.@4c. for Tees, and 4c. for Beams.

Wrought Iron Pipe.—The demand during the week has been active and quotations, although unchanged, are inclined to be easier; quotations are about as follows: Gas and Steam Pipes, 57½ per cent., and Boiler Tubes, 45@47½ per cent. off list price.

Railway Fastenings.—Spikes are in good demand and firm at about 3c.@3.1c.; Fish Plates, 2.6c.@2.75c.; Bolts and Nuts, 3.75c.@4.25c.

PITTSBURGH, Pa., Oct. 10, 1882.

Manufactured Iron.—Manufacturers generally report business as being fair, and while but few, if any of them, are pressed with orders, they are all in good spirits in expectation of a fairly active and healthy business during the remainder of the year. Large jobbers and consumers as well are disposed to hold back until the market becomes more settled. We continue to quote card prices: Merchant Bars, $2.50 rates; No. 24 Sheet, $4.30; Tank, $3.30; Skelp Iron, $2.75@$2.85.

Nails.—There is no abatement in the demand, and makers are assured of a good trade until the close of the year. The outlook for a good Nail trade has not been so encouraging for many years. Prices remain unchanged at $3.40 rates, 60 days, 2 per cent. off for cash, with usual abatement of 10c. per keg on car-load lots and upward.

Wrought-Iron Pipe.—The mills are now all in operation, and as yet have accumulated no stock; as is always the case, small sizes are most in demand, and manufacturers are unable to catch up with their orders for these. Prices remain unchanged; Boiler Tubes, 45@47½ per cent. off; Oil-well Casing, 70c. per foot, net; ditto Tubing, 20c. The improvement in oil is likely to cause an increased demand for all kinds of oil-well supplies.

Railway Track Supplies.—Railway Spikes remain unchanged at 3c., 30 days. Splice Bars are quoted at 2½c.; and Track Bolts at 3¾c. with square, and 3.90c.@4c. with hexagon nuts. There is an increasing demand for all kinds of railway supplies.

CHICAGO, Oct. 9, 1882.

Manufactured Iron.—Merchant Iron has been in very good demand during the week past; back orders are being filled as rapidly as possible, and altogether a better feeling exists among dealers and consumers than heretofore. We note a change in quotations, Bar Iron being now quoted at 2.70c.@2.90c.; Angle, 4c.; T, 4½c.; Beams and Channels, 4¼c.@4½c.; Hoop at 4c.; Sheet, Plate and Tank, 10 to 14 gauge, 4c.; 15 to 17 ditto, 4.30c.; 18 to 21 ditto, 4.60c.; 22 to 24 ditto, 4.80c.; 25 to 26 ditto, 5c., and 27 ditto, 5.20c. Patent Cold-rolled Shafting, dis. 20 per cent.; Norway Iron, Original Bars, 5c. rates; Norway Iron, re-rolled, 6c. rates; Ulster Iron, 4½c. rates; Low Moor Iron, 8c. rates; Nuts and Washers, 7½c. off list; Wrought Boat Spikes, 3½c. rates.

RECENT INVENTIONS PATENTED DURING THE PRESENT WEEK.

INSULATING UNDERGROUND ELECTRIC WIRES.

This improved method of insulating underground telegraph wires consists in placing a row of wires longitudinally in a receptacle. The wires are then covered with silicate of soda in a fluid state, and permitting it to harden. Another row of wires is then arranged on the hardened insulating silicate material, and treated in the same manner. The silicate of soda is in direct contact with the wires.

ARCHED GIRDER.

The arch-sections of this girder are so formed, having transverse cylindrical end extensions and corresponding recesses, as to cause the endwise compression thereof, resulting from the tensile strain on the tie rod, on which they rest through vertical supporting braces, to act in the line of the intrados of the arch.

EXCAVATING MACHINE.

In this invention the lower end of an inclined trough and the inner end of the plow rest in a stirrup suspended by arms to a frame, moving in vertical guides on the frame of the machine, and operated by boothed segments engaging cogs thereon, the shaft of the segments having a lever and pawl engaging a rack. An endless elevating chain, carrying hoes, which move through the trough, consists of sections having a plate to which each hoe is secured. The lower end of the chain passes around a sprocket-wheel, having its shaft bearings in spring followers in a slotted frame, and having its free end resting on lugs on the adjustable plow frame. The shaft bearings of the upper sprocket-wheel of the chain are formed on the sides of the dirt-box. The chain is driven by gearing with teeth on the operating wheels. The upper end of the trough rests on a bent plate hinged to the framing. The bottom of the dirt-box consists of drop doors hinged to plates on the sides of the box, and operated by bell cranks, open links and rods connecting with levers at the driver's seat.

TRUSS BRIDGE.

This truss is built up of light material, interlaced and arranged to take the strains, and spiked or bolted. Vertical end posts, a series of horizontal girders, diagonal braces and vertical tie-rods are combined together. In other words, the posts or uprights are composed of separated strips, and the series of horizontal chords are also composed of separated strips fitting between the strips of the post and secured therein. The diagonal lattice braces are secured to and through the horizontal chords, extending the whole distance from the bottom to the top chords.

APPARATUS FOR DREDGING HARBORS.

This improvement comprises a water-ballasted boat, a changeable water-ballast to obviate effect of rise and fall of tide, a vertical pump-tube provided with spiral propellers in swells of the tube, said propellers being open in their axial region, a rotary foot-tube and digging-bit hinged to the pump-tube by a hollow knuckle-joint, a turn-table carrying the tubes, and mechanism to cause a slow forward and rapid back movement for automatically rotating the turn-table and to cause the foot-tube to work on a horizontal plane.

WASHINGTON, D. C. F. B. BROCK.

MORE PHILADELPHIA ENGINEERING.

The discussion in the Councils on the subject of street pavements does not indicate that familiarity that should be possessed by those who undertake to decide what kind of pavement is best adapted to particular streets and roads. Both the proposed asphalte pavement on North Broad street and the Telford drive on Twenty-second street were objected to on the ground that the city should avoid "patent" pavements. The ignorance herein displayed is appalling. If, instead of proposing to macadamize a road, we should speak of a Macadam pavement, Councilmen would probably take alarm. The fact is that the Telford is simply the improvement on the Macadam roadway that is in common use on many of the best drives in and around the city. The Macadam is a surface composed wholly of broken stone, while the Telford consists of layers of broken stone on a sub-pavement of stone blocks. It makes an excellent drive, but it requires continual sprinkling to keep down the dust and a system of minute daily repairs to prevent its wearing into ruts. It is not adapted to city traffic, but for the Park drives it is the right thing, and perhaps, also, for the needed drive to the Park.

As for asphalte, a real asphalte pavement, such as may be seen in Paris and London, is never to be confounded with the patented imitations—abominations of coal-tar and the like—of which we have had so many sad experiences. These things are not to be considered for any important thoroughfares, but every engineer knows that a good asphalte pavement on a concrete foundation combines more of the essential qualities of a good pavement than anything else, including even granite blocks, except for the hard pound of central thoroughfares in town. For such use as would be required on North Broad street the asphalte pavement is far better than the Belgian. It costs less and is nearly as durable, unless the stone blocks be unusually well chosen and unusually well laid. It is more easily cleaned than any other pavement, has no interstices to harbor filth, and makes altogether the smoothest, quietest, cleanest and pleasantest driveway that can be laid. This refers, of course, to thoroughly good work, and nothing else is worth having.

It is one of the queer things about the government of Philadelphia that although there is a Chief Engineer he has nothing to do with the building of roads, and the Chief of the Highway Department does not profess to be an engineer or even a road-builder. This very important subject, requiring large professional knowledge and experienced supervision, is thus left to amateurs or to the chance decisions of a committee of Councilmen who may or may not know anything of the subject. The result is that the contractors generally determine what kind of pavements shall be laid, and then lay them in such a way that they are probably the worst in the world.—*The Times, 11th.*

NORTH SEA CANAL.

One of the most remarkable of the great canal projects now occupying the attention of engineers is that of uniting the North Sea with the Mediterranean. Like most other enterprises of this character, it is old in conception, dating back, it is claimed, to the beginning of the Christian era. Four years ago it took a definite shape in a plan for a canal from Marseilles to Lyons and then to Dunkirk. During the present year a substitute was suggested in the form of a canal from Bordeaux to Narbonne. This latter plan, though possessing great advantages in point of distance, the route being much shorter and less expensive than the other, yet, on the other hand, is less attractive as an enterprise of vast scope, since it would merely connect the Bay of Biscay with the Mediterranean, cutting off the doubling of the Spanish peninsula. Whichever project is selected, it would be remarkable to find the earth's surface so cut up that a ship may pass from Bombay to St. Petersburg solely through inland waters, as it would be able to do by using the Suez, the French and the Danish canals, the three being designed for the largest commercial vessels

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AND
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GEO. H. FROST.....EDITOR AND PROPRIETOR.
S. D. V. BURR.....ASSOCIATE EDITOR.

SATURDAY, OCTOBER 14, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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THE NEW ENGLAND WATER-WORKS ASSOCIATION is in session at Salem, Mass., this week. The preliminary meeting was held April 9, 1882, in Boston. The first annual meeting was held at the same place June 21, when a Constitution and By-laws were adopted, and officers elected. The President is James W. Lyon, of Salem, Mass.; Secretary, R. C. P. Coggeshall, of New Bedford, Mass. There are 27 active members now enrolled. With four exceptions, they are Massachusetts water-works superintendents. The Association is so conservative and modest that it has heretofore carefully abstained from sending us any notice of meetings or report of proceedings. No doubt these meetings are productive of much valuable information to water-works managers and superintendents.

TO WATER-WORKS OFFICIALS.

"The History and Statistics of American Water-Works," which has been appearing in our columns since March, 1881, now comprises statistics of 387 towns. There are about 200 more towns which have water-works. To the officers of every one of these works at least three appeals have been made for information, and to some of them four requests have been sent, but they neglect to answer. If any persons who can give information regarding the water-works in the following towns of over 10,000 population, which are all the places of that size from which replies have not been received, will send a postal card to us stating their willingness to furnish the necessary data, a blank form will be sent showing what kind of information is wanted:

Biddeford, Me	Long Island City, N. Y.
Brockton, Mass.	Los Angeles, Cal.
Burlington, Vt.	Mobile, Ala.
Camden, N. J.	Muskegon, Mich.
Canton, Ohio.	Portland, Oregon.
Chattanooga, Tenn.	Pottsville, Pa.
Cohoes, N. Y.	Rock Island, Ill.
Columbus, S. C.	Rutland, Vt.
Dallas, Texas.	Sacramento, Cal.
Davenport, Ia.	Saginaw, Mich.
Dover, N. H.	San Antonio, Tex.
Easton, Pa.	San José, Cal.
Evansville, Ind.	Shenandoah, Pa.
Galveston, Tex.	Springfield, Ill.
Haverhill, Mass.	Stamford, Conn.
Hyde Park, Ill.	Stockton, Cal.
Joliet, Ill.	Steubenville, Ohio.
LaCrosse, Wis.	St. Joseph, Mo.
Lewiston, Me.	Wheeling, W. Va.
Little Rock, Ark.	Youngstown, Ohio.

We hope water-works officials, and others who may possess the desired information, will assist us in completing this very valuable and interesting compilation. Already its value is being appreciated and it is consulted, so far as published, by parties in search of water-works data. The instances of this from Des Moines and Albany, which we publish elsewhere this week, are but two of many such that are occurring all the time. We have had numerous inquiries for the completed book, and also many expressions of satisfaction from water-works people concerning it. If an effort were only made, we could soon push it to completion, and thus put at the disposal of interested parties a treatise to which there will be no equal for convenience of reference in any other specialty in public works construction. We again urge the possessors of the desired information to put forth an extra effort in our behalf, and their own.

IMPROVEMENT OF POTOMAC RIVER.

The last Congress made an appropriation of $400,000 for improving the Potomac River in the vicinity of Washington. This referred to the improvement of navigation, the establishment of harbor lines and the reclamation of the flats. The plan proposed by Major P. C. Hains has been accepted, and in accordance with it the work will be carried forward. It is estimated that the cost of the improvement will be about $2,500,000.

The improvement of navigation will be accomplished by dredging a channel from Easby's Point, near Georgetown, to near Giesboro' Point, below the Arsenal, and from there to Long Bridge, in the Washington channel. This will be of a depth sufficient to float any vessel that can reach Giesboro' Point; 20 ft. will enable vessels drawing 22 ft. to reach Georgetown and Washington. Closing the Washington channel at the foot of Fourteenth street and raising the flats will contract the river and make it necessary to provide such a width to the Georgetown channel as will carry the discharge. According to the plans, the least sectional area at low tide should be not less than 25,000 sq. ft.; high water section, 32,875 sq. ft., and freshet section not less than 48,000 sq. ft. The excavation required is as follows:

	Cubic yards.
In Georgetown Channel	6,259,570
In Washington "	1,723,792
From south end of Long Bridge	300,000
Total	8,283,362

Additional material for filling the flats can be obtained from the shoal near the proposed bulkhead wall on the upper side of Long Bridge, and from other places.

The proposed harbor lines are described as follows:

The bulkhead will commence near Easby's Wharf and extend in curved line to a point at or near the southerly end of the causeway of the Long Bridge, thence continuing to a point at the intersection of the Washington and Georgetown channels, below the wharf of the United States Arsenal, thence returning along the westerly side of the Washington channel in front of the city wharves and about 800 feet distant from them to Long Bridge. The bulkhead line adjacent to the city, from Fourteenth street to Greenleaf's Point, is of irregular form and follows along the inner end of the wharves from Fourteenth street to the Arsenal.

The raising of the flats will be accomplished by depositing on them the material obtained from the channels, and from other sources. The areas to be reclaimed are as follows: About Long Bridge, 420 acres, of which 127 acres will be occupied by lakes; area below the bridge, 330 acres; total, 750 acres. The total amount of material required to raise the flats to the proposed grade will be about 12,000,000 cubic yards. Of this amount 8,283,362 cubic yards will be obtained from the channels and from the south end of Long Bridge; 1,824,090 cubic yards by dredging from the lakes, and the remainder, about 1,892,548 cubic yards, from other sources.

The estimated cost of the work is as follows:

10,107,452 cubic yards of material taken from dredged channels and lakes, at 18 cents	$1,819,341
892,548 cubic yards from other sources, at 18 cents	340,658
Revetment wall of reclaimed area	173,555
Revetment wall of lakes	66,000
Outlet and inlet sluice gates, as estimated by the late Major Twining	70,000
Contingencies	246,955
Total	$2,716,509

Further on it is explained that the price of "18 cents per cubic yard for dredging and depositing the material is considered low. It is hardly to be expected that the work can be done at a lower figure unless a contract could be made for at least one half of the entire work at one time."

Of the $400,000 appropriated, $300,000 will be expended in dredging a channel from deep water near Giesboro' Point to Georgetown, 20 ft. deep and as wide as it can be made for that sum—it is estimated that it can be made 400 ft. wide. The material excavated will measure about 1,700,000 cubic yards. (Proposals for this work will be received by Major P. C. Hains, Engineer Corps, U. S. A., until Oct. 30. For advertisement we refer to page X. this issue.) The sum of $70,000 will be applied to the construction of the inlet and outlet sluiceways for filling the lake referred to and purifying the water in the Washington channel. The remaining $30,000 to be allotted to office expenses, contingencies, etc.

The specifications state that the channel will be about 20 ft. deep at low water, and 400 ft. wide. The length to be dredged above Long Bridge will be about 7,500 ft., and below the bridge about 4,000 ft. The depth of cutting will be from 1 to 12 ft. The material to be excavated has been found to be sand and mud. The excavated material will be deposited on the Potomac Flats within the bulkhead lines to be established by the engineer. The amount of material to be dredged above the bridge is 1,100,000, and below the bridge, 600,000. The work must be completed by August 31, 1883.

SIXTH ANNUAL REPORT OF THE BOSTON WATER BOARD, 1881-82.

From the report of the Boston Water Board for the year 1881 we have gleaned the following:

Daily average consumption, 38,214,900 gallons, equivalent to 92 gallons per head of population.

Total revenue from use of water, $1,323,171.23.

Total number of meters in use (including water motors), 1,727.

Daily average consumption through meters, 601,750 gallons.

Number of families supplied, 78,916.

Length of supply and distributing mains, 489.5 miles.

Total cost of construction of works, $18,577,972.69.

The works are stated to be, with few exceptions, in good condition. The great increase in the consumption during the past few years has had the effect of taxing the capacity of the works to their utmost. At the present time a storage reservoir, having a capacity of 1,100,000,000 gallons, is being constructed on Stony Brook, a branch of the Sudbury River, and the report contains a recommendation that work upon still another reservoir should be at once begun.

The question of the prevention of waste is considered at some length, and a detailed account is given (illustrated by diagrams) of experiments made with the Deacon waste-water meter in the Charlestown district. The further application of this system of waste prevention is recommended.

PERSONAL.

Mr. C. A. HAMMOND has been appointed superintendent of the Boston, Revere Beach & Lynn railroad, in place of Mr. EDWARD H. WHARF, resigned. Mr. L. C. LEGRO, late master of transportation, has resigned.

MR. HAMMOND, engineer and general manager of an important Brazilian railroad, bears strong testimony to the value of coffee as a preventive against miasmatic fevers. He instances the case of Father Vaughan, who, on a journey through a most unhealthy country from Panama to the River Platte, considered that he owed his health to taking strong coffee, and mentions that since the natives in pestilent districts in Ecuador have taken to drinking it the death rate has fallen considerably.

GENERAL WILLIAM SOOY SMITH & SON, civil engineers and contractors, have opened offices in the new Montauk block in Chicago. They have just closed an important contract for the substructure of a bridge across the Yazoo River for the Memphis, Vicksburg & New Orleans road. The foundations are considered very difficult, owing to the nature of the soil and of the river. The water is ordinarily 30 ft. deep, but at certain seasons rises to a total depth of 80 ft.

UNLESS M. DE LESSEP'S son VICTOR has misrepresented him, the cleaver of the continents, who is revising the plan of creation in the matter of isthmuses and seas, recently cut a caper in Egypt which must have staggered even the melodramatic appetites of a French audience. "My august father," says M. VICTOR DE LESSEPS, describing a scene which he says occurred at the time of the seizure of the canal by Sir GARNET WOLSELY, "my august father was not wanting to the occasion. He had round his neck a paper collar of English make. He did not hesitate for a moment, but tore it off and danced on it. This was his response to the insolence of the invader." The picture is interesting and suggestive. What a field for heroism it opens to our own SPINOLA! If by this saltatory sacrifice of his shirt-collar M. DE LESSEPS merely meant to express his contempt for perfidious Albion in the abstract, it would be harsh to pronounce it ridiculous. An insult to a flag is an insult, whether it is offered to the ensign of a man-of-war or of a mud-scow. And who can tell whether, in the present Jingoist condition not only of the British mind in general but of the mind of GLADSTONE in particular, an insult to a British paper collar, there being no other emblem of the hated island available, might serve at least to foment a diplomatic correspondence? On the other hand, if M. DE LESSEPS' wrath was kindled against his paper collar as a paper collar of British make, it is clear that, if in his wrath he remembers logic, he should have treated with similar ignominy all other articles of his wearing apparel which had been produced by English cloth-workers or English tailors. The spectacle of M. DE LESSEPS rending his inner garments in a paroxysm of wrath, like King Lear, and repelling the insolence of an invader by dancing on his own shirt-collar, though possibly to be commended as strictly and severely logical, could scarcely have failed even in Paris to provoke Homeric laughter. Hereafter, therefore, the action of dancing upon one's shirt-collar will be classed in the same category with the mediæval custom of biting the thumb, or the more modern practice—to quote from Irwin's lament for Donnybrook—of

> "Trailing the coat in courageous defiance
> And shouting the pilaloo! over the green."
> —*N. Y. World.*

WATER-WORKS FOR IRVINGTON, N. Y.

Irvington-on-the-Hudson has long felt the need of a pure and abundant supply of water for domestic and fire purposes. The village is situated on the eastern bank of the river, and now obtains its supply from wells and cisterns. The drainage of the vaults and cesspools on the elevated portions of the hill foul the waters below, and, as a consequence, the lower residents find it impossible to obtain a good supply. Some time since plans were prepared for a system of water-works to cost $75,000, but the scheme was defeated by the people at the polls, as the estimate was deemed too high.

Now, the President and Trustees of the village have organized as a Board of Water Commissioners, and have appointed W. A. Burnham, president; William Walker, treasurer, and Adam Busch, secretary. Plans and specifications were prepared by the firm of R. D. Wood & Co., of Philadelphia, who guarantee that the entire expense, including the land, will not be more than $35,000.

A short distance back of the village is a ravine through which flows a stream; by building a dam across the lower extremity of this a reservoir would be obtained of between 3,500,000 and 4,000,000 gallons capacity. The supply during the dry seasons has been estimated to be about 30,000 gallons daily, which, with the reserve provided by the reservoir, would be ample for some years to come. Should any addition be required by an increase of population or otherwise, it could be built at any time and at a proportionate cost as though built at the present time. The average head of water on Broadway (a street running parallel with the river and a short distance up the hill) will be about 100 feet, efficient for fire purposes at any point and insuring an ample flow through all the branches.

To-day—the 14th—the tax-payers vote on the proposition, and, judging from conversations we have had with several of the citizens, it seems that the plan will be sanctioned.

PROPOSALS.

Should the vote be favorable proposals for furnishing the materials and doing the work will be received until next Saturday, the 21st inst. In view of these facts we herewith publish the specifications in full; any further information can be obtained from the officers of the commission above named:

SP ECIFICATIONS.

The work to be done is the construction of a stone and earth dam across the brook and side embankment with the necessary racks and screens and filter chambers; also the grubbing and cleaning of the space to be occupied by the reservoir and embankment; also the furnishing and laying of a supply main and the village system of distribution, the setting of valves and hydrants, all as shown on the accompanying plans and map, and the following description of the work to be done.

The entire space to be covered by water, or the embankment, shall have all perishable matter removed therefrom.

The reservoir to be built is formed by the construction of an earth and stone dam at the lower end, and low side embankment.

The main embankment shall be constructed as shown upon the plans. The dam proper shall be of rubble masonry, with a cut-stone coping over the entire top.

The cut-off wall shall be of rubble masonry. All interstices in the dam and cut-off wall shall be filled full of spalls and cement, so as to insure as water-tight work as can be made in that manner. All the joints on the outer and inner face of the dam shall be cleaned out to a depth of two inches and pointed flush with the face of the work with a cement mortar, composed of one part cement and one part of sand.

The side embankments will be formed from earth taken from the reservoir ground, and will follow generally the flow line as indicated, and of the dimensions shown on the plan.

The inner or water side of the main earth embankment shall be made of the finer portions of the excavated materials, and shall be put on in horizontal layers one foot thick and well wet, and rammed or rolled before the next layer is placed; the outer bank shall be composed of the coarser portions from the excavations.

All dimensions of this dam and embankments, and all work connected with it, shall be as shown on the accompanying drawings, copies of which will be furnished to the contractor.

The cement mortar used in the masonry shall be composed of one part of best quality of Rosendale or equally good cement; and two parts of clean, sharp sand.

The screen and gate chamber in the dam shall be constructed as shown on the plan, with a screen frame of pine, fastened to the wall in front of the affluent pipe, in which a fine copper screen fastened to an iron frame and sliding in grooves so as to be easily taken out for cleaning. The gates shall have the valve stems lengthened, so as to be operated with a short wrench from the top of the dam.

The filter gallery will be constructed of dry rubble masonry, also the masonry at the end of the mud and inlet pipe.

The inlet pipe will have a wrought-iron rack over its upper end.

The filter bed will be composed of round or broken stone, 18 in. deep, varying in size from 2 to 6 in. in diameter. Over the stone will be a layer of screened gravel, 15 in. in depth, varying in size from ¼ to 1 in. in diameter. Over the gravel will be a layer of clean sand 18 in. in depth.

At the upper end of the reservoir will be constructed an oak rack, as shown, resting against a dry rubble masonry abutment, and held in place with heavy iron bolts.

Along the back side of both side embankments will be excavated ditches 5 ft. wide and to a depth level with the spill-way of the dam.

The creek, for a distance of 500 ft. above the reservoir, shall be excavated to a uniform width of 12 ft. and to a depth of 1 ft. below the level of the spill-way of the dam.

The screen chamber will be covered with a double pine flooring, and matched and cross-boarded, and arranged with trap-doors convenient for raising the screen and operating the gates. The doors shall have wrought-iron hinges and lock and hasps.

The position of the mud-pipe, the distribution pipe, the valves, the amount of slope wall, dry wall, stone-filling, sand and gravel-filling, cut-off wall and dam masonry, screens and rack, shall be as shown, and built under and to the satisfaction of the engineer in charge, in the employ of the Board of Water Commissioners.

The pipe shall not be less than 12 ft. long, exclusive of hub, truly cylindrical, of the full internal diameter, and the inner and outer surfaces concentric and straight in the axis of the cylinder. All plain pipe shall be cast vertically in dry sand moulds, and of such quality of iron as to produce strong and tough castings that may be satisfactorily cut and drilled, and the iron in the pipe shall have a tensile strength of at least 16,000 lbs. to the square inch.

All pipe and specials shall be sound and smooth, without blister, cold shuts, or other imperfections, and the iron shall be free from admixture of cinder, scoria, or sand.

All castings shall be thoroughly cleaned without the use of acids, or other liquids, and uniformly coated with suitable coalpitch and oil.

And all pipes shall be tested at the foundry to a hydrostatic pressure of 300 lbs. to the square inch, and should the Water Commissioners so require, a sworn statement that the pipe has been so tested shall be furnished by the superintendent of the foundry to them.

All castings must have their weight distinctly marked on each piece with white paint.

The system of piping will consist of 144 lineal ft. of 12-in. pipe, 4,310 ft. of 8-in. pipe, 2,608 ft. of 6-in. pipe, 7,678 ft. of 4-in. pipe; three 12-in., two 8-in., three 6-in., three 4-in. valves, with box and covers; 17 double hose 4-in. stand-pipe hydrants, 6 lawn hydrants, most durable pattern.

SPECIAL CASTINGS.

1—12 inch, ⅛ bend.	1— 6 ¹⁴ 6 branch.
1—12 " 8 reducer.	1— 6—4 reducer.
1— 8 " ⅛ bend.	7— 4 ¹⁴ 4 branches.
1— 8 ¹⁸ 8 branch.	1— 6 inch plug.
3— 8 ¹⁶ 8 "	2— 4 " "
1— 8 inch, 6 reducer.	2— 8 " sleeves.
1— 8 " 4 "	3— 6 " "
1— 8 ¹⁴ 8 branch.	4— 4 " "

All pipes shall be laid 4 ft. below the surface of the road or street to the top of the pipe.

All the hydrants shall be set on the terrace between the curbing and sidewalk, and at points shown on the plan.

All pipes shall be laid, all hydrants and valves set, and branches placed where shown by the map, or may be directed by the engineer in charge.

All valves shall have a square wooden box made of 1½ in. frame and about 6 in. inside, reaching from the top of the valve case to the surface of the street and capped with a suitable iron cover, with the initials W. W. in raised letters cast on the upper side.

All hydrants shall have a movable frost jacket.

All hydrants and valves shall be of a kind and make approved by the Board of Water Commissioners.

The lawn hydrants shall be located where shown by the map, and connected with the main or hydrant branch with a ⅝-in. heavy lead pipe.

All hydrants shall have a drip cock so arranged as to remain open when the valve is closed.

The contractor shall furnish the village, free of charge, two valve wrenches, and two hydrant and hose coupling wrenches.

All joints shall be made with a good quality of jute, well compacted, and soft lead firmly upset. The 12 and 8-in. pipe shall have in depth of lead 1¾ inches, and the 6 and 4-in. pipe, 1½ inches in depth.

The material excavated from the trenches shall be returned to them in such order that that taken from the surface may be returned to the same place, and all back filling shall be well rammed, and the streets restored to as good condition as before as nearly as practicable.

All surplus material must be removed from the streets at the contractor's expense. No large stones will be allowed to be put in with the back filling within one foot over the pipe.

In blasting rock in the trenches due caution must be exercised in loading blasts so as to avoid damaging property. In case any person or property is in any way injured by blasting, the contractor shall be liable, and pay all such damages so incurred.

WEIGHT OF PIPE.

Each length of pipe shall weigh as follows:

	12 inch diameter.		12 feet long			805 lbs.
Class A.	8 "	"	12 "	"		476 "
" B.	8 "	"	12 "	"		534 "
" B.	6 "	"	12 "	"		372 "
" C.	6 "	"	12 "	"		389 "
	4 "	"	12 "	"		228 "

No allowance will be made for any excess above weights, and no pipe will be accepted or allowed laid that is more than 5 per cent. under the above standard. Weights prescribed for their respective locations as follows:

	144 feet	12 inch	at the dam.	
Class A.	2,000 "	8 "	from the dam, west on Mountain road.	
Class B.	1,200 "	8 "	on Mountain road.	
" B.	1,110 "	8 "	" Broadway.	
" B.	450 "	6 "	" "	
" B.	655 "	6 "	" Main street from B'way, west.	
" C.	1,500 "	6 "	" " " below Aqueduct.	
	3,170 "	4 "	" Broadway from 450 feet N. of Main street, south.	
	4,300 "	4 "	" Broadway from Mountain road, south.	
	204 "	4 "	" hydrant branches.	

CEDAR PAVEMENTS IN TORONTO.

The Committee on Roads in the Toronto Council have just awarded about $100,000 worth of contracts for cedar block paving of King street, from Don to Strachan avenue. From the abstract of tenders before us we note a great uniformity of prices throughout the whole distance. From the prices we judge that A. W. Godson was awarded the contract. His prices are as follows: Pavement per square yard, $1.15 to $1.19; stone curbing per lineal foot, 26c.; stone curbing, 80c. to 90c.; crossing plates per 100 lbs., $2.50; moving track per 100 lineal ft., $20. The names of parties tendering were: A. J. McBean, A. W. Godson, Geo. Farquhar & Co., Ardagh & Leonard, Trimble & Co., Richard West, R. Dinnis. Godson & West have also completed, this season, a system of sewerage for Parkdale, a suburb of Toronto, the total being about 7½ miles, at a cost of $60,000.

GOVERNMENT CONTRACTS LET.

The following is a synopsis of certain government works in charge of Colonel G. L. Gillespie, Corps of Engineers, U. S. A., with the proposals recently received for furnishing the materials and doing the work.

Proposals for improving the Shrewsbury River, N. J.; dredging in the main stream and the two branches, and for the construction of 500 ft. of light dike; appropriation $30,000.

LIST OF BIDS.

Names.	Dredging. Price per cu. yd.	Diking per lin. ft.
Elijah Brainard	.35¾	$5.50
H. DuBois & Sons	no bid	5 00
Frank Pidgeon, Jr	48 3-10	4.00

Awarded to Elijah Brainard.

Proposals for dredging in Flushing Bay, N. Y.; appropriation, $6,000.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley & A. J. Beardsley	$0.19½
Frank Pidgeon, Jr	.29

Awarded to H. N. & A. J. Beardsley.

Proposals for dredging channel from Canarsie Landing to Jamaica Bay, N. Y.; appropriation, $7,200.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley & A. J. Beardsley	$0.50 at sea, .40 in bay.
John McDermott	$0.67
Elijah Brainard	.48

Awarded to Elijah Brainard.

Proposals for dredging in Woodbridge Creek, N. J.; appropriation, $5,000.

LIST OF BIDS.

Names.	Price per cu. yd.
John McDermott	$0.74
John M. Weldon	.73
John H. Fenner	.65
E. Brainard and T. H. Benton, C. Somers	.65
	.75

Awarded to Messrs. Brainard & Benton.

Proposals for dredging in Newton Creek, east of Vernon Avenue Bridge, N. Y.; appropriation, $15,000.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley, A. J. Beardsley	$0.27
J. W. Ambrose, D. Ambrose and R. J. Mills.	.29
C. H. Loomis	.40

Awarded to H. N. & A. J. Beardsley.

Proposals for improving Cheesequakes Creek, N. Y., by the construction of rubble jetties and timber dikes and by dredging; amount available, $35,000.

LIST OF BIDS.

Names.	Price for dredging per cu. yd.	Price for stone in jetties per cu. yd.	Price for timber platform foundation per sq. yd.	Price for sheet pile revetment per lin. ft.
J. M. Weldon	.49	$4.50	$2.60	$8 double. $6 single.
H. Du Bois & Sons	.50	1.85	1.80	*
S. R. Cummings	.25½	2.50	2.30	$4.41
Frank Pidgeon, Jr	.53	1.50	1.89	5.95
E. Brainard, T. H. Benton	.60	1.75	1.40	6.87
F. C. Somers	.43½	....	....	....

*$6.07 for 200 ft., $7.17 for 2,000 with anchor piles.

Awarded to S. R. Cumming.

Proposals for improving Sumpawanus Inlet, Long Island, N. Y., dredging channel from Babylon Landing to Great South Bay; amount available, $6,200.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley, A. J. Beardsley	$1.40 if towed away. $1.25 if dumped in bay.
J. McDermott	.69
E. Brainard	.84

Awarded to J. McDermott.

Proposals for improving Sheepshead Bay, N. Y., for dredging a cut to connect east end of Sheepshead Bay with Dead Horse Inlet; amount available, $9,000.

LIST OF BIDS.

Names.	Price per cu. yd.
H. N. Beardsley, A. J. Beardsley	$0.45
J. McDermott	.67
F. Pidgeon, Jr	.53
E. Brainard	.73

Awarded to H. N. & A J. Beardsley.

Proposals for the construction of the south jetty at the entrance to Manasquan Harbor, N. J.; amount available, $7,000.

LIST OF BIDS.

Names.	Price of timber jetty per lineal ft.	Price of stone in jetty per cu. yd.
S. A. Kelly	$11.00 for outer 200 ft, 9.00 " following 100 ft, 8.00 " inner 200 ft.	$2.50
H. DuBois & Sons	13.50	5.00

Awarded to S. A. Kelly.

Proposals for dredging 140,000 cubic yards, more or less, from the channel between Staten Island and New Jersey; appropriation, $40,000.

Names.	Price per cu. yd.
C. H. Loomis	$0.24
E. Brainard, T. H. Benton	.34
Morris & Cummings Dredging Co	.23¾
J. W. Ambrose, D. Ambrose, R. J. Mills.	.40

Awarded to Morris & Cummings Dredging Co.

Proposals for dredging 200,000 cubic yards, approximately, from the mouth of the Passaic River, extending up stream toward Newark, N. J.; appropriation, $43,000.

LIST OF BIDS.

Names.	Prices per cu. yd.
E. Brainard, T. H. Benton	$0.35
Morris & Cummings Dredging Co	.22½
J. H. Fenner	.29
E. M. Payn	.24 9-10
J. McDermott	.41
J. W. Ambrose, D. Ambrose, R. J. Mills.	.55

Awarded to Morris & Cummings Dredging Co.

Proposals for dredging Mattawan Creek, New Jersey; appropriation, $6,000.

LIST OF BIDS.

Names.	Prices per cu. yd.
F. Pidgeon, Jr	$0.59
F. C. Somers	.68
E. Brainard, T. H. Benton	.71
J. McDermott	.69

Awarded to F. Pidgeon, Jr.

EXPERT OPINION OF BOOKS.

DETROIT, September 25, 1882.

To the Editors of the American Architect:

SIRS: Please state the best work on Strains in Structures, Heating and Ventilation; also the best work on Graphic Statics. Yours, etc.,

STUDENT.

[Rankine's "Applied Mechanics," Moseley's "Mechanics of Engineering and Architecture," or Peclet, "Traité de la Chaleur," Box on "Heat," Baldwin's "Practical Treatise on Steam Heating," and the articles in Buck's "Cyclopædia of Hygiene." Greene's "Graphical Analyses," Parts I., II. and III.—*Eds. American Architect.*]

CORRESPONDENCE.

VALUE OF COAL DUST AS FUEL.

KANSAS CITY, Mo., Oct. 3, 1882

EDITOR ENGINEERING NEWS:

DEAR SIR: I would like to hear through the columns of your paper something about the progress being made in the burning of fine coal dust. I learn from what ought to be good authority, that claims are made that one ton of finely comminuted coal dust, fed into a furnace by air blast, is found to do the work of from two to three tons of raw coal burned in the usual manner. If any such facts exist, it seems singular that it receives so little attention from the scientific press. As this would tend to lengthen the apparently short lease of life given to the steam engine by the promoters of gas and electric substitutes, it seems to me that a few paragraphs from parties having actual knowledge on this subject would be of value.

Yours truly, G. W. PEARSONS.

AMERICAN ENGINEERS IN MEXICO.

HACIENDA DE SANTA BARBARA, Sept. 18, 1882. Estado de Jalisco.

EDITOR ENGINEERING NEWS:

Since my arrival in Mexico, nearly one year ago, I have missed your weekly greeting in ENGINEERING NEWS very much. I would suggest, in the interest of the large number of engineers now employed in Mexico, that the weekly issue be retained for your Mexican subscribers, subject to order on return to the States. I, for one, should regret very much being unable to complete my file of your paper, which contains in each issue so much valuable information for engineers in every department of the profession, and I know by sad experience that papers mailed to Mexico rarely reach their destination. I am now in charge of the work at the extreme point of the road, as resident engineer, with headquarters as above. I have a house, built of adobe or mud, one story high, as office, etc., with three rooms and kitchen. My amusement in the morning, before breakfast, is to hunt allacrans, and I usually succeed in finding two or three victims. The sting of the allacran, at this altitude (6,200 ft. above sea level) is not dangerous but is extremely disagreeable in its effects, being much more painful than a wasp or hornet's bite in the States. Living here in the country would disgust many of your readers. It is difficult to get any meat fit to eat, and yet every day we see abundance of quail, wild duck, snipe, etc., which the natives leave unmolested. Jack rabbits, as we term them on account of their resemblance to a jackass, are very numerous, and are immense compared with our American rabbit, being fully three times the size of the latter. The success of the Mexican Central seems assured. The rolling-stock now on hand is inadequate to handle the unexpectedly large demand made upon the freight department, and the receipts so far exceed the most sanguine predictions of the projectors of the road. The Mexican government and the people have a most friendly feeling towards the enterprise, and a rich return awaits the capitalists who invested in the enterprise while its success was problematical. I have examined with much interest the hydraulic works of the country, used for irrigation, and many of your readers versed in that department of engineering would be surprised to see the method of construction adopted for dams in Mexico, which have stood the test of service for years. The "presa," or reservoir dams, are almost universally built of two walls of masonry, filled between with earth, and the cross-section used would cause an American engineer to tremble for the safety of the structure. The theory adopted by the contractors, of course, is that the earth filling, being puddled, and of suitable

material, will secure the *tightness* of the dam, the masonry serving only as walls to retain the earth and pressure of water. I intend, as leisure permits, to procure accurate measurements of some of the large fresh dams in the vicinity, and shall take pleasure in laying them before your readers for theoretical discussion. My address for the present is—Lagos, Estado de Jalisco, Mexico, and if you have a stray item of news I should be pleased to hear from you. We generally expect to receive about one paper out of six mailed, and then the news is about a month old. Sincerely yours,

C. H. M. BLAKE.

LITERATURE.

DRINKER'S TUNNELING.

The new edition of this standard work, which has been so eagerly looked for, has at last made its appearance. The delay has been due to the anxiety of its author to have the latest data on explosives and rock drills in the work, and many new cuts have been required, which it has taken much time to make. We congratulate both author and publishers on its appearance. The work is better printed and the paper seems to be an improvement, while the binding is stronger. The additions have been principally made in Chapters III., IV., V., VI. and VII., treating of explosives and drills. The latest of the various modern destructive agents will be found elaborately described, and all the new drills and compressors. More than 200 pages have been added in these chapters; also, several folding plates on tunnels appear at the back, and descriptions are in the text. Among them we notice several East Indian tunnels, and the celebrated Hudson River Tunnel. This being a book by an American engineer of celebrity, will undoubtedly take precedence over the much inferior works of Simms and André, notwithstanding the difference in price. The poorest economy for an engineer is to buy a CHEAP book. It may cost him not only reputation, but many thousands of dollars. We shall have copies for our subscribers and general customers, to whom we heartily commend it.

BALTIMORE.

Baltimore deserves to be known also as the City of Hills. Steep grades and sudden descents are the rule, a level street is the exception. The horse cars have a hard time of it, and have to station extra horses at every few corners to help tug the loaded cars up some steep grade. Many of the lines run only bob-tail cars, without a conductor, and find even these abundant work for two horses. A line of Herdics was once attempted, but given up in despair. Those vehicles might work well on the broad, smooth, and level avenues of Washington, but they were not suited for the cobble-stone pavements and numerous hills of Baltimore. Another result of the inequality of surface is the surface system of drainage. There are but few sewers in the city, and those are laid along the valleys to carry off water which would otherwise flood them in every storm. Nothing perhaps strikes the visitor more oddly and unpleasantly than to see in every gutter a constant stream of waste water, and find every few yards a little channel in the sidewalk, along which trickles the drainage from the neighboring house. It seems to him that, with such primitive neglect of a proper sewer system, the city must be a cesspool of disease. And yet its health average is high, particularly when we remember the difficulty of checking small-pox and such contagious diseases among the negroes. One secret of this is the abundant water supply. The former supply was sufficient for the city at present, but looking toward the future she has just completed a new system of reservoirs and aqueducts, which furnish her with a larger supply than the Croton can possibly give New York. Water is the cheapest of all necessities, and is profusely used. Each morning the gutters are flushed, the sidewalks washed off, and the city treated to a most healthy scrubbing. Again, every rain floods the streets and prevents the accumulation of filth in them. A smart shower will quickly gather volume enough from the hillsides to transform the lower avenues into brawling brooks and necessitate the use of the high stepping stones which are planted along the crossings in the older streets. Such a shower will do more toward cleaning the city than "Plunger" Walton and his carts could accomplish in a week.—*Correspondence Boston Journal.*

THE HENDERSON BRIDGE.

The following account of the work on this bridge has been furnished to the Henderson (Ky.) *Reporter*:

The bridge is being built by the Henderson Bridge Company, to connect the Louisville & Nashville Railroad south of the Ohio River with its St. Louis division and the other railways centering at Evansville. Its foundation will involve difficulties greater than those of any bridge west of the Alleghenies, excepting the bridge at St. Louis. There will be 16 spans with an iron viaduct approach on the Kentucky side, making a total length of 3,686 feet. The channel span will be 525 feet, the longest trussed span in the world. Of the 16 piers, at least six will be sunk by the pneumatic process to solid rock, which is about 42 feet below low water, and 54 feet below present water level. The grade of the bridge will be 53 feet above high water, or about 100 feet above lowest stage of the river.

The caisson just launched is about 54 feet long, 22 feet wide, and 13 feet high. Four courses of timber will be added at once, making the total height 17 feet when ready for sinking. This caisson, when completed, will contain 153,000 feet, board measure, of white oak, and about 23 tons of iron in form of shoe-tie rods, screw-bolts and drifts. The total weight of material in the caisson will be about 450 tons.

The caissons for channel span, work on one of which is well advanced, will be about one-third larger than the caisson just launched.

The high water in late spring and early summer encroached upon the limited space in which the caissons could be built, and prevented that rapid prosecution of the work which had been expected. The river has remained high, and the ways for launching had to be placed for 60 feet of their length in water ranging from nothing to 16 feet in depth. Every care was necessary, and much time was spent in securing this portion of the ways. There were 25 piles under the caisson; these with others beyond them supported four lines of ways, having a slope of about one inch to a foot at starting; this increased corresponding to a vertical curve of 550 feet radius until in depth of 12 feet of water; the average inclination was 3½ inches to a foot. The caisson was built level and kept on carriages made to fit the ways; these carriages were connected in pairs, and excepting the bearing surface were built of poplar timber so as to insure their floating out as soon as they were free from the caisson. The carriages were tied back by lines which were strained by screws and jacks; when all the blocking had been removed these ropes were cut, liberating the caisson; the huge mass started slowly and smoothly, its velocity increasing until checked by the water; sufficient impetus had been gained, however, to push it into water deep enough to float it.

When the timber courses have been added, the temporary bottom, put in to confine the air space and insure floating, will be pushed out under the bottom edge, and, masonry being added on top, the caisson will be forced to the bottom of the river, and into it as rapidly as the laborers can excavate under the cutting edge. A pressure will be maintained at all times sufficient to keep water out of the chamber in which the work of excavation is conducted. The caisson passes through about 15 feet of gravel and 15 feet of soapstone shale, reaching the sandstone bed-rock. The air chamber is then filled with concrete, and the mass, solid, immovable and imperishable, forms the foundation of the tall pier which is to carry its portion of the steel bridge and railway traffic, 140 feet above its base.

The work on the bridge is now well started, and will be pushed forward as rapidly as practicable. The pier and abutments will require about 25,000 cubic yards of masonry. Large quantities of stone have already been delivered, and three quarries are now actively working to furnish limestone for the work: one at Baker's station, near Nashville; one at Russelville, and one at West Fork, near Pembroke station. Fine qualities of limestone are obtained from these points. Timber is now being delivered for two more caissons, which will be built this fall. The chief engineer of the Henderson Bridge Company is Mr. F. W. Vaughan, of Louisville; Mr. O. F. Nichols is resident engineer in charge of work at Henderson.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.—Alderman King, as Chairman of the Committee on Water-Works, presented on the 5th the following report on the troubles existing between the city of Des Moines, Ia., and the Water Company:

To the Hon. Mayor and Members of the City Council:

GENTLEMEN: The special committee, to whom was referred the resolution declaring the charter of the Water-Works Company forfeited on account of the failure of said company to comply with th conditions, requirements and terms of said contract, have the honor to report that we have had several joint meetings with a committee of the aforesaid company, with a view to a settlement of the trouble existing between the city and the company, and regret to say that we feel confident that there is no reasonable probability of said company ever consenting to such a just and equitable adjustment of the differences referred to as in the judgment of your committee would be a fair and reasonable compensation for the service rendered by said company in extinguishing fires and other requirements demanded by said charter. We deeply deplore the obstinacy of the company to agree to a reasonable modification of its rents consistent with the character of the service rendered. But aside from the question of extortion, the people of this city have just cause for alarm on account of the serious risk to which they are exposed by the negligence and fault of said water company to afford sufficient protection against fire. The facts developed in this controversy clearly prove the following propositions, viz.:

First, That the company are absolutely unable to comply with the essential requirements of its contract, and have been unable to so comply for the last eighteen months, if ever.

Second, The unsafe, unprotected and dangerous risk to which the city is at this time subject, appeals to this Council for some adequate relief or some suitable provision looking to that protection which a tax levy for fire protection has a right to receive.

Third, From all the evidence before your committee, gleaned from exhaustive statistics published in ENGINEERING NEWS, in which the question of water supply is elaborately treated on—as to cost, pressure, capacity of works, rate per hydrant and nearly all other matters having a bearing upon the question of water supply, hence your committee have deliberately concluded that in the event that the City Council shall agree to a new contract with said company, a fair and sufficient compensation for furnishing a sufficient supply of pure filtered water for the use of the citizens of this city and for protection against fire,—

Recommend that the following shall be a basis of settlement for a new contract, to wit: The company to be prepared at all times to furnish a sufficient supply of pure filtered water for public and private use and good fire protection. This to be an invariable requirement, not to be violated for any cause whatsoever, and for this service the city shall pay to said company the annual rent of $75 for each hydrant, not exceeding two hundred in number; $40 for the next hundred hydrants, and $30 per hydrant for the next three hundred hydrants, making the whole number provided for six hundred, at the different prices above named; the water company to furnish and set all hydrants hereafter ordered put down by the City Council, and to purchase the hydrants now in use.

All matters of detail which may be necessary to carry out a new contract between the city and water company to be submitted to the consideration of the Council for ratification before the same shall have any binding force upon this city.

M. H. KING.
S. A. ROBERTSON.
LEWIS HYLAND.
GEORGE GARVER.

The report was adopted without debate.—*Des Moines Register, 6th.*

WATER WORKS.—ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL, New York, is publishing a very interesting series of articles on the History and Statistics of American Water-Works, by J. James R. Croes, M. Am. Soc. C. E. In the number for Sept. 30, the Annapolis, Md., water-works are explained. The supply is obtained from a number of springs and small streams, collected in a well and thence pumped into a reservoir. The banks of this reservoir are puddled with clay and paved with granite. A brick trough is constructed three feet under the bottom of the reservoir and covered with wooden slats, one-half inch apart, on which coarse gravel is laid, with layers of finer on top, and a foot of sand over all. Through this the water filters, and is then conducted four miles to the city through a ten-inch main of cast-iron. Thus the city of Annapolis is supplied, in the first place, with pure spring and active live water, which is also filtered. The water for this city, we believe, is not subjected to filtration; but it should be. Letting it settle in the reservoir, we think, is not enough. If it were possible to draw the water off from the reservoirs and put filtering bottoms in them, that should be done as soon as possible.—*Albany, N. Y., Daily Press and Knickerbocker, 9th.*

MESSRS. THACHER & BREYMANN, the well-known submarine contractors, of Toledo, O., have been engaged since Aug. 1 in laying two lines of water-pipe across Cumberland River, at Nashville, Tenn. They expect to return to Toledo next week. This firm finds a steady demand for their services in the submarine work of water-works construction.

THE SOUTH ABINGTON WATER SUPPLY.—The committee chosen in town meeting July 22 to take into consideration the question of a water supply and fire department for this town, have submitted a written report. It contains three plans. One, the building of seven large reservoirs, to be filled by a steam fire engine from adjacent ponds, and the purchase of a fire engine, the necessary accoutrements and three Harkness extinguishers, at a total expense of $13,240.

The second plan is to lay about three miles of pipe through the principal streets, with 20 hydrants, connecting with the pump in the factory of Dunbar, Hobart & Whidden. By this means, the pump being put in operation, sufficient force would be obtained to throw water over any building within 1,000 feet of the hydrants. The expense attending this plan, including three Harkness extinguishers, is estimated at $16,890.

The third plan is to locate a reservoir 30 ft. in diameter and 60 ft. high on Tilson Mill, near the town,

and to lay about seven miles of pipe to carry the water through the town, furnishing it for a fire department, for family use, etc. Estimates of cost, including two Harkness extinguishers, $40,000. This plan the committee, by the advice of Mr. Geo. H. Norman, of Boston, unanimously recommend, and, realizing that cost will be the great objection, they suggest, should the town build the proposed works, that the money be raised by issuing water bonds, payable in twenty years or more, and that the income from water rents be used to pay the interest, thereby preventing direct taxation and the increase of taxes.

The committee have gone over the ground carefully, and it is believed that what they recommend will be adopted. It is the most able town report we have ever seen.—*Boston Journal, Oct. 7.*

IN DANGER FROM A WEAK DAM.—PROVIDENCE, R. I., Oct. 9.—Fresh signs of weakness having been discovered in the Georgiaville dam, which holds a large body of water, eight miles above Providence, the Commissioner of Dams and Reservoirs this afternoon made a further representation to the Supreme Court of the danger, and the Court ordered that the Bernon Manufacturing Company forthwith draw off the water in the pond so far as can be done by the opening of the gates, and that the gates be kept open until further orders of the Court. The pond is nearly 40 ft. deep, and can be lowered only 9 ft. by the gates. If the dam should go out, a large business section of the city could hardly escape destruction.

COVINGTON, KY.—The surveys for the new reservoirs on Forest Hill are about completed. There is a strong probability that the question of erecting the reservoir will be submitted to the people at the coming January election.

THE last of the pipe-laying for the city water-works at Madison, Wis., was completed the other day. The twelve miles of mains will be tested this week by a pressure of 150 to 200 lbs. to the square inch.

FIGHTING AGAINST A DAM.—PITTSFIELD, Mass., Oct. 10.—The trial of the Smith Paper Company, of Lee, for maintaining a nuisance in the form of a dam across the Housatonic River, near Lenox, began to-day before Chief Justice Brigham. The indictment alleges that since 1876 the dam has set back the water over an expanse of low, flat country, which land the water alternately overflows and leaves bare, with the exception of stagnant water, which gathers in pools. From these pools stenches and smells arise which have been the cause of the fever and ague that has for three or four years past infected the neighborhood. The defense will ascribe the sickness to the unhealty condition of the residences.

THE WASHINGTON WATER-WORKS EXTENSION.—Major Lydecker has submitted a preliminary report to General Wright, the chief of engineers, U. S. A., on the extension of the water-works. No maps or plans accompany the report. General Wright will examine into it himself before placing the report before the Secretary of War. The details of securing the lands necessary, the surveys, plans, etc., have all to be agreed upon, and it will take some time yet before anything can be done. General Wright intends to push the matter as fast as possible.

WATER FOR RAILROADS.—The Wisconsin Central Railroad Company are doing away with wind-mills along their line and putting in engines and pumps to fill their water tanks at the various stations.

GAS METERS.—One hundred new meters have been ordered in Minneapolis, Minn., since the gas-light company reduced the price to $2.50 per 1,000 feet.

GAS VS. ELECTRICITY.—FOND DU LAC, Wis., Oct. 3.—A number of our leading citizens, comprising some of the heaviest taxpayers in the city, have petitioned the Common Council not to adopt the tower system of electric lighting now on trial in this city, alleging that it is unsatisfactory and that the city can be lighted much cheaper with gas.

THE Feloit Water Company will begin the construction of first-class city water-works by the 1st of May next.

THE Danville, Ill., Water Company was incorporated on the 9th. Capital stock, $125,000: incorporators, John Long, Clifton Rodes Barrett, and Harry H. Hodgson.

RAILROADS.

THE Roodhouse & Scottsville Railway Company has filed articles of incorporation. The road is to be constructed, commencing at Roodhouse, county of Greene, Ill., running thence in an easterly direction near or through Athensville in said county, to Scottsville, in the county of Macoupin. Incorporators: George P. Merrill, Milton McClure, R. B. Shirley, of Carlinville; James Walker, of Scottsville; James L. Patterson, John Jones, John Roodhouse, of Roodhouse, and William C. Shirley, of Stanton.

CHICAGO, Oct. 11.—The Chicago & Hannibal (Mo.) Railroad Company was incorporated at Springfield yesterday. The capital stock is $2,000,000, which Moses J. Richards, one of the leading incorporators, says has been all taken. The road is to be about 280 miles long, but the precise route is not yet determined.

THE Grand Trunk system now embraces 3,330 miles.

A ROAD, to cost $3,000,000, is to be built from Brooklyn, Ill., to Shawneetown.

THE Wheeling & Lake Erie Railroad has been opened from Wheeling to Detroit.

A SHORT line is to be opened up by the Missouri Pacific from Kansas City to St. Louis.

THE California Southern is completed to San Diego, 669 miles from San Francisco.

A RAILROAD is to be built between Buffalo and Toronto. It will be 10 miles shorter than any existing road.

TRAINS are to be running on Nov. 1 on the Chicago & Atlantic Railroad between Chicago and Marion, O. 250 miles.

THE New York, West Shore & Buffalo Railroad, when completed will, it is said, be the most expensive road ever constructed for the distance.

THE Denver & South Park division of the Gunnison branch is now completed to Gunnison, 207 miles from Denver, 72 miles from the main line at Buena Vista.

IN Texas, 1,461 miles of new roads were constructed last year, costing nearly $50,000,000. The State has now thirty-four railroads, aggregating 5,908 miles in length.

THE gross earnings of the Pennsylvania Railroad for July were $4,149,150 on the Eastern lines, the largest ever known. The net gain for the month was almost half a million dollars.

THERE are now employed on the New York, West Shore & Buffalo, and the New York, Ontario & Western Railroads, from Weekawken to Middletown and from Cornwall to Syracuse, 18,294 men, 115 steam and compressed-air drills, 14 steam excavators, and 4 dredging machines. There are also 3,131 horses and carts, 27 locomotives, 1,080 cars, 14 pile drivers, 76 steam derricks, 10 steam pumps, and 23 tugs, barges and canal boats.

IN round numbers 7,000 miles of railroad has been constructed so far this year, against 4,200 miles for same time last year. The earnings show a corresponding improvement. During July 68 roads, aggregating 51,020 miles, reported aggregate earnings of $30,019,504, or 10 per cent. more than for the same month last year. For seven months, ending July 31, 62 railroads, aggregating 49,470 miles, earned $198,633,720, or 12.4 per cent. more than last year.

A NEW NARROW GAUGE RAILROAD.—Since the recent survey of the proposed routes of the Bangor & Piscataquis Railroad extension has demonstrated the fact that the present location of the road is the proper one, the Massachusetts capitalists who control the great slate quarries of Monson, seeing that there is no prospect of the Bangor & Piscataquis road ever passing through the village, have decided to build a narrow-gauge road from their quarries to some point on the Bangor & Piscataquis. The gentlemen mentioned have secured the services of Mr. Wm. M. Brown, son of Hon. Arthur Brown, Superintendent of the Bangor & Piscataquis, as engineer, and the work of laying out the route has already been commenced.

NEW ILLINOIS ROAD.—The Illinois, Iowa & Minnesota Railroad Company have filed articles of incorporation with the Secretary of State; capital stock, $2,000,000. It is proposed to construct a line from Streator through the counties of La Salle, Bureau, Whiteside and Rock Island to a point on the Mississippi River near Princeton or Clinton, Iowa.

A NEW LINE.—The Wisconsin Central Railroad Company has commenced the construction of a new line from Chelsea, a station on the main line, to Rib Lake, a lumbering point sixteen miles northeast. The branch is to be completed this fall, and will involve an expenditure of $200,000. Other branches are contemplated that will prove not only beneficial to the people, but profitable to the corporation.

COST OF RUNNING A TRAIN.—A recent report of a prominent railroad gives the cost of running a train of less than 400 passengers per daily trip of 93 miles as follows:

Items of cost.	No.	Description.	Amount.
Wages of engineer	1	Day.	$3.36
Wages of fireman	1	Day.	2.08
Wages of conductor	1	Day.	2.03
Wages of baggage-master	1	Day.	1.95
Wages of brakemen	2	Day.	3.80
Anthracite coal for fuel	2.7	Tons.	6.94
Wood for kindling	.1	Cords.	.40
Water used	4	M. Galls.	.24
Oil and tallow for engine and tender, including lamps		Trip.	.62
Oil and grease for cars		Trip.	.19
Repairs of engine and tender	93	Miles.	4.33
Repairs of and refitting cars		Trip.	7.23
Hands at depots, extra engines, etc.		Trip.	2.01
Sundries for train, gas and all other expenses		Trip.	2.20
			$38.18

Equal to 10.18 cents per passenger, at 376 passengers per train.

NEW STREET RAILROAD.—The Altoona & Allegheny Street Railroad Company, of Altoona, Pa., has filed articles of incorporation. Capital, $20,000.

A CHARTER was issued at Harrisburg on Friday last to the Gettysburg & Harrisburg Railroad Company, whose line is to extend from Hunter's Run, on the South Mountain Railroad, between Mount Holly and Pine Grove Furnace, to Gettysburg, a distance of 22 miles. The capital stock is $250,000, and is owned by Jay Cooke, J. C. Fuller, John M. Butler, Jay Cooke, Jr., R. J. Woodward, Charles D. Barney, Spencer Ervin, Philadelphia; Wm. H. Woodward, Carlisle, and Daniel King, Pine Grove Furnace.

ARTICLES of incorporation have been filed for record in the Clerk's office in Carlinville, Ill., of the Roodhouse Branch of the Burlington & Ohio River Railroad, with a capital stock of $200,000. The incorporators are George H. Merrill, Toledo, O.; M. McClure, Robert B. Shirley, Carlinville; Samuel J. Williams, Gillespie; Jas. Walker, Scottville; John Roodhouse, H. L. Paterson and George Jones, of Roodhouse.

THE Illinois, Iowa & Minnesota Railway Company filed articles of incorporation with the Illinois Secretary of State; capital stock, $2,000,000. It is proposed to start a line from Streaton to a point near Princeton or Clinton, Ia., on the Mississippi River, through the counties of LaSalle, Bureau, Whiteside and Rock Island. The first board of directors are: Ralph Plumb, Elmer Baldwin, Edwin Evans, J. D. Harvey, E. H. Thayer, A. Means and Alex. Campbell.

MEXICAN NOTES.—CITY OF MEXICO, Oct. 10.—The Government has contracted with Delfin Sanchez for the construction of the whole Tehuantepec Railroad. A Stock Exchange has been organized without a charter, by European brokers under the auspices of the Mexican National Bank, and will be opened to-morrow.

ARTICLES of incorporation have been filed in Illinois for the Northwestern Construction Company, the principal office to be at Dubuque. The company will construct and equip the railroad lines of the Chicago, Freeport & St. Paul Railroad Company. The capital stock of the new construction company is fixed at $1,000,000.

PROPOSALS are wanted to build a 2 ft. gauge railroad, from Skowhegan to Athens (Maine), a distance of 12¼ miles. The location has just been completed, and the work will be let as soon as bids can be obtained. For information, address A. S. C. Hall, East Madison.

SKOWHEGAN, Oct. 8. Yours, S. W. BATES.

CONTRACTS LET.

ANNUAL REPORT.—We learn from the advance sheets of the forthcoming annual report of the Builders' Exchange, Cincinnati, that during the year last past a total of 34,000 cubic yards of sand was used in connection with building in that city at a total cost of over $120,000; and that the amount of lime used was 600,000 bushels.

OSGOOD & MCNAUGHTON, of Albany, N. Y., have received an order from the Panama Railroad Company for one of their combined steam excavator and derrick cars.

AMERICAN CONTRACTS FOR AN EDINBURGH FIRM.—Messrs. Stuart & Co., Edinburgh, have just completed contracts for laying with their "granolithic"—the material put down some years ago on the south side of Princes street—the sidewalks of the Pennsylvania avenue, Washington, and the broad pavements surrounding the new post-office, Philadelphia. The pavements in each case are nearly 20 ft. wide, and the contracts amount respectively to 20,000 square yards, costing about £8,000, and 15,000 square yards, costing about £6,000.—*Contract Journal, London.*

NEWPORT, Oct. 10.—The contract for dredging the Providence River was to-day awarded to the Atlantic Dredging Company, Brooklyn, at 16 cents per cubic yard. The contract for excavating Taunton River was awarded, one portion to W. H. Beard, of Brooklyn, and the other portion to J. H. Fenner, of Jersey City. The contract for excavating Little Narragansett Bay in Rhode Island and Connecticut was awarded to the Hartford Dredging Company, of Hartford, at 20 9-10 cents per cubic yard.

BIDS were opened at the Treasury Department Monday for repairs to the revenue steamer Boutwell at Baltimore, as follows: Malster & Renney, of Baltimore, $17,000; Ramsey & Co., of Baltimore, $20,000.

THE CENTRAL BRIDGE, LOWELL, MASS. CONTRACT AWARDED.—The Central Bridge Committee have awarded the contract for the superstructure. There was a general interchange of opinion in regard to the merits of the various bridges offered, and a discussion of prices, etc. The committee determined to make the award among five of the dozen bidders, rejecting the rest for informalities or other reasons. It was finally voted to give the contract to the Morse Bridge Company of Youngstown, Ohio, the lowest bidders, the work to be done to the satisfaction of the City Engineer. The Mayor was authorized to sign the contract on behalf of the city. The following were the five proposals considered:

Morse Bridge Co., Youngstown, O.	$51,590
Wrought Iron Bridge Co., Canton, O.	58,853
Phœnixville Bridge Works, Phœnixville, Pa.	59,580
Boston Bridge Works	59,600
Corrugated Metal Co., Berlin, Conn.	60,862

The bids for the lock and lock gates at the Bridgeport (Chicago) pumping-works were opened recently, the lowest bidder being O. B. Green, who offers to take the contract for $35,000.

CANALS.

TO BUILD A SHIP CANAL.—CHICAGO, Oct. 10.—The Illinois Improvement Company, of Chicago, was incorporated at Springfield to-day. Its object is to build a ship canal from Lake Michigan to Grand Crossing, a point at which all the Eastern trunk lines converge.

BUILDING.

HOUSTON COUNTY, Minn., is to have a new court-house, patterned after that at St. Peter, which cost $23,000.

A NEW SCHOOL HOUSE, to cost $20,000, is to be built in Minneapolis, Min., this year.

NEW SCHOOL HOUSE.—Ishpeming, Mich., is to have a $15,000 school house.

LABOR.

A STRIKE ON THE NORTHERN PACIFIC.—SAN FRANCISCO, Oct. 10.—Twenty-five hundred white construction employés of the Northern Pacific Railroad in Montana struck on Saturday on account of an advance in the board rate of half a dollar per week. There was no violence. The supervising engineer telegraphed that the new board would be maintained. It is thought the men will return to work. The Chinese, numbering 5,000, were not in the strike.

BRIDGES.

NEW BRIDGE AT BISMARCK.—About the 18th inst. five large engines from the west and five from the east will meet on the new bridge spanning the Missouri at Bismarck for the purpose of testing it and formally opening it for traffic.

NEW BRIDGE ACROSS THE MISSOURI.—It was stated yesterday that the Burlington and Quincy people are considering the project of building a new bridge across the Missouri at Randolph Point, thereby securing an independent entrance into Kansas City, without recourse to the Hannibal & St. Joseph bridge. The Milwaukee & St. Paul also desires entrance into Kansas City, and will be likely to join hands with the Burlington in the project of building a new bridge if it assumes a practicable shape.